Invasive Species: Course Outline

I. Natural History of Invasive Species in Iowa
   A. Historical Perspective of Iowa's Invasive Species
      1. Definition
      2. Characteristics
      3. Species Distribution
         a. Iowa
         b. United States
      4. Pathways
         a. Intentional
         b. Unintentional
   B. Invasive Species Ecology
      1. Habitat Groupings
         a. Aquatic
         b. Prairie/Grassland
         c. Forest/Savanna
         d. Urban Area
         e. Roadsides
      2. Competition with Natives
      3. Impacts
   C. Identification
      1. Using Dichotomous Keys
      2. Using Identification Guides
   D. Growth
      1. Life Cycles
      2. Methods of Reproduction
      3. Site Requirements

II. Invasive Species Management
   a. Economics
   b. Agencies/Funding Sources
      1. Local
      2. State
      3. Federal
   c. Laws and Regulations
      1. Invasive Species
      2. Exotic Species
      3. Noxious Weeds
   d. Control
      1. Preventing Spread
      2. Physical
      3. Chemical
      4. Biological
      5. Habitats
         a. Aquatic

b. Forest
c. Prairie
d. Roadside
e. Urban

III. Careers Associated with Invasive Species
A. Governmental
1. Local
2. State
3. Federal
B. Private

IV. Appendix
A. Terms
B. Resources
C. Curriculum Standards
1. Agriculture
2. Science

Invasive Species: Terms

adaptable
alien
ballast
biodiversity
biological control
chemical control
competition
defoliate
endangered
endemic
eradicate
exotic
fragmentation
Hazard Analysis and Critical Control Point (HACCP)
herbicide
indigenous
infestation
injurious wildlife species
insecticide
invasive
non-native
noxious weed
nuisance
parasitic
pathogen
pathway
pesticide
physical control
piscicide
predator
rapid response
risk assessment
screening
threatened
veliger

Invasive Species: Resources

The following resources were suggested by the writers and reviewers. There are many additional resources available and many more being developed daily, especially via the web. Website resources contain lists of publications related to specific topics. Individual books or pamphlets from websites were not listed because of space. Please view these as a starting point and add others to the list as you develop your specific course objectives.

Websites:

Center for Aquatic and Invasive Plants

Wetland and Invasive Plant Information Retrieval System (**APIRS**).
http://aquat1.ifas.ufl.edu/welcome.html

Center for Invasive Plant Management

Their "Invasive Plant Resource Guide" is a collection of materials designed to support invasive species management and education
http://www.weedcenter.org/resource_guide/rg_cover.html

Conservation Districts of Iowa

Conservation Districts of Iowa (CDI) is a nonprofit organization devoted to providing educational programs on the conservation of soil, water, and other natural resources. CDI coordinates Iowa's Envirothon program.
http://www.cdiowa.org

Invasive and Exotic Species

Information and images of invasive and exotic species
http://www.invasive.org

Invasive Plants of the Eastern United States

Invasive plants of the Eastern United States identification and control
http://www.invasive.org/eastern/

Iowa Department of Agriculture and Land Stewardship

Office of Plant Pathologist/State Weed Commissioner, information and publications related to Iowa's Agriculture and Conservation/Natural Resource issues and programs
http://www.agriculture.state.ia.us/default.htm

Iowa Department of Natural Resources – Aquatic Nuisance Species Program

Information on invasive species laws, lists, control
http://www.iowadnr.gov/fish/news/exotics/exotics.html/

Iowa State University Extension Publications

Extensive publication list related to plant and animal species, and their management.
http://www.extension.iastate.edu/pubs

Stop Aquatic Hitchhikers

A site for recreational users who want to help stop aquatic nuisance species
http://www.protectyourwaters.net

The Nature Conservancy Wildland Invasive Species Team

This web site provides many resources designed to help all conservationists deal most effectively with invasive species
http://tncweeds.ucdavis.edu/

Books, CD's, Pamphlets:

Background Information on Iowa's Aquatic, Forest, and Wildlife Resources. IDNR, http://www.iowadnr.gov/education/backinfo.html

Biodiversity CD. IDNR, Contains information about Iowa's Aquatic habitats and the types of organisms living in them. Order from AquaticEd_Info@dnr.iowa.gov

Field Guides. A variety of Field Guides, each with their own unique qualities, are available from many sources. It is important to know how to use a Field Guide to identify specimens.

Invasive Plants of the Upper Midwest: An Illustrated Guide to Their Identification and Control. Czarapata, Elizabeth J. 2005. The University of Wisconsin Press. http://www.wisc.edu/wisconsinpress/

Managing Our Natural Resources. Camp, William G., etal. 2002. DELMAR, 4th ed. http://www.Agriscience.Delmar.com

Global Environmental Change: Introduced Species. National Science Teachers Association. 1998. ISBN 0-87355-164-8. Stock Number PB138X04.

Nonindigenous Fishes Introduced Into Inland Waters of the United States. Fuller, Pam L., Leo G. Nico, and James D. Williams. 1999. American Fisheries Society Special Publication 27. http://www.fisheries.org

Invasive Species: Curriculum Standards and Benchmarks

Agricultural Education
Standards, Benchmarks, and Performance Indicators

Agricultural Business, Supply & Service

Standard AB-1: Understand problem-solving, analysis, and decision-making in agriculture.

Benchmarks
A. Analyze situation, use problem-solving approach and make appropriate decisions.

1. Compare the advantages and disadvantages of biological, chemical and cultural pest controls.

Agricultural Production

Standard AP-12: Understand basic technical skills and knowledge in the occupational area of production agriculture.

Benchmark
K. Apply technical skills in a hands-on experiential setting in agriculture.

4. Analyze the environmental effect that agricultural stewardship may have on surface and ground water, wildlife, soil, air, and people.
20. Explain the factors involved with seed and plant selection.
21. Identify and demonstrate plant growth and reproduction.
22. Identify and select biological and chemical pest controls for agronomic production.
34. Use the survey plat of township, range and section to describe an area.

Horticulture

Standard H-1: Understand problem solving, analysis, and decision-making in agriculture.

Benchmarks
A. Analyze situation, use problem-solving approach and make appropriate decisions.

1. Identify and differentiate between (may be a combination of) disease damage, pest and insect damage, chemical and environmental damage in a plant.
2. Use observational techniques to identify healthy, quality plants.

Standard H-8: Understand the concept of adapting to change in agriculture.

Benchmark
H. Develop strategies to effectively adapt to new situations and rapid changes in agriculture.

3. Identify issues and trends in horticulture concerning environmental and conservation problems.

Standard H-12: Understand basic technical skills and knowledge in the occupational area of Horticulture.

Benchmark
L. Apply technical skills in a hands-on experiential setting in agriculture.

26. Identify plants using a botanical key.
27. Identify herbaceous and woody ornamental plants by common name.
51. Explain the process of photosynthesis.
52. Explain factors affecting plant growth: light, water, temperature, humidity, nutrients (micro/macro) soils, atmosphere, and pollutants.
53. Explain the principles of nutrient uptake.
54. Define and identify hardiness zones.
55. Explain the system of scientific nomenclature for plants (e.g., families, genus, and species).
65. Explain the principles of integrated pest management.

Natural Resources

Standard NR-1: Understand problem solving, analysis, and decision-making in agriculture.

Benchmark
A. Analyze situation, use problem-solving approach and make appropriate decisions.

3. Evaluate benefits and uses of native plants and animals, as well as their negative uses.
6. Evaluate means of solving Iowa forest resource problems.

Standard NR-4: Understand the use of entrepreneurial knowledge and skills in agriculture.

Benchmark
D. Use appropriate communication skills in a variety of occupational situations in agriculture.

3. Recognize the importance of technical assistance.

Standard NR-7: Understand the principles of planning.

Benchmark
G. Apply planning strategies in natural resources management.

1. Develop an individual resource conservation plan to include crop, pasture, woodlands, wildlife, farmstead, and urban considerations.

Standard NR-8: Understand the concept of adapting to change in agriculture.

Benchmark
H. Develop strategies to effectively adapt to new situations and rapid changes in agriculture.

1. Identify contemporary natural resources issues/concerns relating to agriculture.
2. Adapt to environment/situation.

Standard NR-9: Understand global and cultural diversity issues.

Benchmark
I. Demonstrate a working knowledge of the relationship between global/cultural diversity and occupational success in agriculture.

1. Describe global environmental impact.
2. Explain global positioning systems and graphic information systems and understand practice application.

Standard NR-11: Understand the concept of career development and improvement – lifelong learning.

Benchmark
K. Develop strategies to make a successful transition from school to work.

1. Identify a minimum of five (5) environmental and natural resource occupations and explain the job requirements, major activities performed by persons in these occupations and availability by location.
2. Explain the connection between the natural resources occupations, agribusiness, and technology.

Standard NR-12: Understand basic technical skills and knowledge in the occupational area of natural resources.

Benchmark
L. Apply technical skills in a hands-on experiential setting in agriculture.

1. Explain the economic impact of the loss of wildlife, habitat, urban sprawl, and navigation on wildlife resources.
5. Describe the connections between land use, rural Iowa, and agriculture.
6. Locate a plot of land given a legal description.
8. Explain the impact agriculture, industry, and population centers have on natural resources and the environment.
9. Use soil survey, topography maps, aerial photos, and other natural resources inventories to interpret, compare (limits and potentials), and plan wise land management.

10. Identify federal, state, and local regulations related to soil and water conservation, water quality, forestry, air quality, and wildlife. Explain their applicability to resource management.
20. Describe how Iowa climate and weather is relevant to natural resources and agricultural resource management.
21. Identify techniques for improvement of aquatic habitats.
22. Identify a minimum of ten aquatic plants and ten aquatic animals common to Iowa.
25. Explain the principles of integrated crop (fertility levels, pests) management.
27. Identify a minimum of 50 plants by their common names.
30. Explain current issues involved in natural resource management.
33. Explain State and Federal Ag and Natural Resource Management Agencies and their functions.
34. Explain the hydrologic cycle.

Source: Iowa Content Standards and Benchmarks for Agricultural Education, Iowa Department of Education, 1999.

Science Standards

Standard 5: Understands the structure and function of cells and organisms.

Level III
3. Knows the levels of organization in living systems, including cells, tissues, organs, organ systems, whole organisms, ecosystems, and the complementary nature of structure and function at each level

5. Knows that organisms have a great variety of body plans and internal structures that serve specific functions for survival (e.g., digestive structures in vertebrates, invertebrates, unicellular organisms, and plants)

Level IV
3. Understands the processes of photosynthesis and respiration in plants (e.g., chloroplasts in plant cells use energy from sunlight to combine molecules of carbon dioxide and water into complex, energy-rich organic compounds and release oxygen to the environment)

4. Knows how cell functions are regulated through changes in the activity of the functions performed by proteins and through the selective expression of individual genes, and how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division

Standard 6: Understands relationships among organisms and their physical environment.

Level IV
1. Knows how the interrelationships and interdependencies among organisms generate stable ecosystems that fluctuate around a state of rough equilibrium for hundreds or thousands of years (e.g., growth of a population is held in check by environmental factors such as depletion of food or nesting sites, increased loss due to larger numbers of predators or parasites)

2. Knows how the amount of life an environment can support is limited by the availability of matter and energy and the ability of the ecosystem to recycle materials

3. Knows that as matter and energy flow through different levels of organization in living systems and between living systems and the physical environment, chemical elements (e.g., carbon, nitrogen) are recombined in different ways

5. Knows ways in which humans can alter the equilibrium of ecosystems, causing potentially irreversible effects (e.g., human population growth, technology, and consumption; human destruction of habitats through direct harvesting, pollution, and atmospheric changes)

Standard 7: Understands biological evolution and the diversity of life.

Level III

1. Knows basic ideas related to biological evolution (e.g., diversity of species is developed through gradual processes over many generations; biological adaptations, such as changes in structure, behavior, or physiology, allow some species to enhance their reproductive success and survival in a particular environment

3. Understands the concept of extinction and its importance in biological evolution (e.g., when the environment changes, the adaptive characteristics of some species are insufficient to allow their survival; extinction is common; most of the species that have lived on the Earth no longer exist)

5. Knows ways in which living things can be classified (e.g., taxonomic groups of plants, animals, and fungi; groups based on the details of organisms' internal and external features; groups based on functions served within an ecosystem such as producers, consumers, and decomposers)

Level IV

2. Understands the concept of natural selection (e.g., when an environment changes, some inherited characteristics become more or less advantageous or neutral, and chance alone can result in characteristics having no survival or reproductive value; this process results in organisms that are well suited for survival in particular environments)

3. Knows how variation of organisms within a species increases the chance of survival of the species, and how the great diversity of species on Earth increases the chance of survival of life in the event of major global changes

7. Knows how organisms are classified into a hierarchy of groups and subgroups based on similarities that reflect their evolutionary relationships (e.g., shared derived characteristics inherited from a common ancestor; degree of kinship estimated from the similarity of DNA sequences)

Standard 12: Understands the nature of scientific inquiry.

Level IV

4. Uses technology (e.g., hand tools, measuring instruments, calculators, computers) and mathematics (e.g., measurement, formulas, charts, graphs) to perform accurate scientific investigations and communications

7. Knows that investigations and public communication among scientists must meet certain criteria in order to result in new knowledge and methods (e.g., arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge; the methods and procedures used to obtain evidence must be clearly reported to enhance opportunities for further investigation)

Standard 13: Understand the scientific enterprise.

Level IV
2. Understands that individuals and teams contribute to science and engineering at different levels of complexity (e.g., an individual may conduct basic field studies; hundreds of people may work together on a major scientific question or technological problem)

3. Understands the ethical traditions associated with the scientific enterprise (e.g., commitment to peer review, truthful reporting about the methods and outcomes of investigations, publication of the results of work) and that scientists who violate these traditions are censored by their peers

5. Understands that science involves different types of work in many different disciplines (e.g., scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations; many scientific investigations require the contributions of individuals from different disciplines; new disciplines of science, such as geophysics and biochemistry, often emerge at the interface of older disciplines)

6. Knows that creativity, imagination, and a good knowledge base are all required in the work of science and engineering

Source: Compendium of K-12 Standards, McREL, 2004.
http://www.mcrel.org/compendium/SubjectTopics.asp?SubjectID=2